Bio Files

October 2013

Missouri S&T Department of Biological Sciences

Upcoming Events

Saturday, October 19 Homecoming game

Graduation Reception December 13
Southwestern Bell Cultural Center 3-5 PM

Graduation Ceremony December 13 6 PM

Cell cycle regulation of cytokinesis proteins

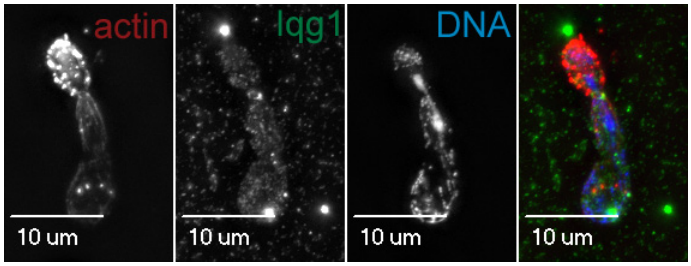
Cytokinesis is the final step in cell division when the cell physically separates into two by contracting a ring composed of filamentous actin (F-actin) and type II myosin. There are dozens of proteins involved in this processes to insure that contraction happens at the right time and place. If contraction were to happen too early it could interrupt chromosomal segregation causing aneuploidy. Aneuploidy, an incorrect number of chromosomes, is seen in 90% of all cancers, and recent evidence suggests that it may be an early event in tumor formation. Research in DR. SHANNON'S Cytokinesis lab focuses on the proteins involved in regulation, assembly, and contraction of the actomyosin ring. A Master's student, DAN MILLER, is studying the regulation of the essential gene IQG1, which encodes a scaffolding protein in budding yeast (*Saccharomyces cerevisiae*) required for actin recruitment to, and contraction of, the actomyosin ring.

Cyclin dependent kinases, or CDKs, drive the cell cycle by phosphorylating target proteins, which can activate or inhibit the protein's function. Looking at the amino acid sequence of Iqg1, the protein has four perfect consensus sites (target sequences) for CDK. The phosphorylation sites flank a region of the protein shown to bind F-actin and recruit it to the site of cytokinesis. To determine if phosphorylation of Iqg1 by CDK negatively regulates actin ring formation Dan mutated the four consensus sites to either prevent or mimic phosphorylation.

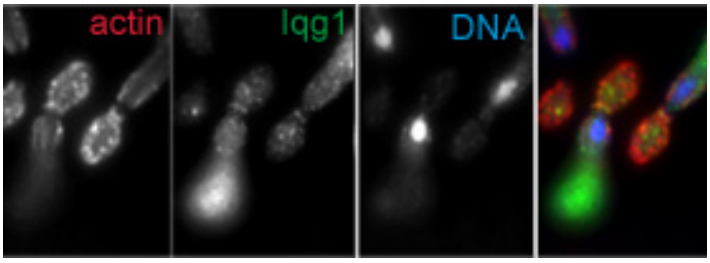
The mutant cells were examined to determine if they had cytokinesis defects. Dan's experiments show that preventing phosphorylation resulted in a 30% increase in cytokinesis defects, while mimicking phosphorylation caused a 15% increase, indicating that phosphorylation of Iqg1 by CDK is important for cytokinesis.

Since CDK's are part of the cellular clock, Dan then wanted to see what kind effect the mutants had on the timing of actin ring formation. To do this, the cells were synchronized in G1, then followed as they divided to see if the mutant strains form the actin rings earlier or later than normal cells. Fluorescence microscopy is used to visualize Iqg1, actin, and the DNA. As shown in the picture, the non-phosphorylatable mutant of Iqg1 forms the the actin ring 20 minutes earlier than control cells. This premature actin ring in the mutant occurs before DNA segregation is complete, unlike normal cells, which only assemble the actin ring after chromosome segregation.

Dan is currently analyzing the timing of ring formation in Iqg1-4E mutant cells, and will determine if the mutants have altered binding to F-actin. Data so far supports the hypothesis that phosphorylation of Iqg1 by CDK inhibits actin ring formation. These findings suggest that precise regulation of during the cell cycle is required to prevent cytokinesis defects.



Formation of a ring containing actin and Iqg1 during mitosis (two blue dots) in control cells



Formation of a ring containing actin and Iqg1 prior to mitosis (single blue dot) in mutant cells with nonphosphorylatable Iqg1

Department Update

The Missouri S&T Department of Biological Sciences is an academic community focused on learning and discovery. The S&T BioSci community provides a supportive, collegial, challenging and rewarding environment for its faculty, students and staff.

Strategic Plan: For the past year, hundreds of S&T faculty, staff, students and administrators have been working on a strategic plan to guide our efforts over the next seven years. For the first time, system funding has been tied to the implementation of the plan. S&T's plan focused on maximizing the return on investment for our key constituencies (students, employers, donors, granting agencies). Our strategy statement is: **"Missouri S&T will provide by 2020 a top return on investment among public research universities to students, employers, research partners and donors through extraordinary access to renowned expertise, services and experiential learning opportunities."** The plan is complex and comprehensive, involving 30 levers (groups of actions) and 188 specific actions, 115 of which are scheduled to begin in the first year.

S&T's plan was very well-received by the Board of Curators, and all three of Year 1 initiatives were fully funded ($3.2 million + $1.26 million S&T match). These include:

- Hiring 100 faculty members over the next 7 years (33 initially). Some positions may involve cluster hiring.
- Improving our teaching laboratories ($500,000)

What this will mean for BioSci is uncertain. We expect to be able to expand our faculty in response to strong growth in student population, the recent loss of a partial faculty position, and the institution of programs in biomedical engineering and biomedical science that will increase departmental teaching activities. Meanwhile, construction of Bertelsmeyer Hall, the new home of the chemical engineering department, is on schedule for completion next summer. We anticipate occupying some of the vacated space while renovations to the older section (i.e., our section) of Schrenk are carried out.

Research: In 2012 BioSci faculty members published 12 peer reviewed research publications, presented 21 papers at national and international meetings, and were invited to give 12 talks in various professional venues. One striking feature of the BioSci department is that all of our regular faculty members are active in research and all engage their students in this process. To sustain these efforts, the department is developing innovative ways to support faculty research. The external funding environment (primarily government funding agencies) has become very, very challenging with extremely low success rates. In response to this situation, the department has developed a series of revenue streams that are directed to faculty research support. These sources include summer school tuition, donations from alumni and friends, return of grant overhead, Project Lead the Way-related income and sales of biotechnology products. This year almost $50,000 is available to support these vital research programs.

Faculty: BioSci faculty have been honored with numerous notable and appointments and awards this year. DR. RONALD FRANK received a Governor's Award for Excellence in Teaching, DR. DEV NIYOGI received a Faculty Teaching Excellence Award, and DR. DAVID WESTENBERG and MS. TERRY WILSON earned CERTI (Center for Educational Research and Teaching Innovation) awards based on student evaluations. DR. MELANIE MORMILE and colleagues received their second US Patent related to the development of biofuels, while DR. ROGER BROWN and colleagues received a patent for the devleopment of glass scaffolds that support tissue regeneration.
eFellow awards to support the redesign of BioSci courses were obtained by DRS. KATIE SHANNON and DAVID WESTENBERG and MS. TERRY WILSON, pictured below.

Students: A record number of students graduated from the BioSci department this year; an even larger number will graduate next year. Of 2013 graduates, 24% transferred from another school, 40% received OURE grants to fund their research while at S&T, and more than half graduated with honors.

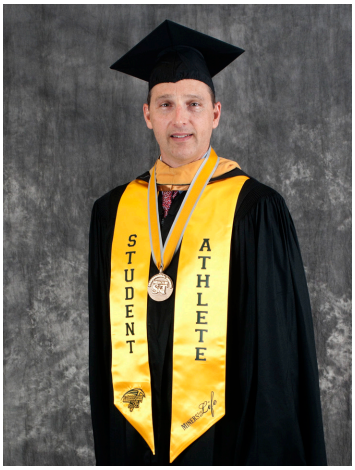
I am pleased to provide you with this update. I had to leave out so much more than I included. Please visit our website (biosci.mst.edu) and our FaceBook Page ("Missouri S&T Biology') for more information about our department. Your comments and suggestions are always welcome. And, of course, I invite you to visit the department for a tour and update.

Sincerely,

Robert S. Aronstam, Ph.D.
Professor and Chair, Biological Sciences

Dr. Phillips receives Professional Degree

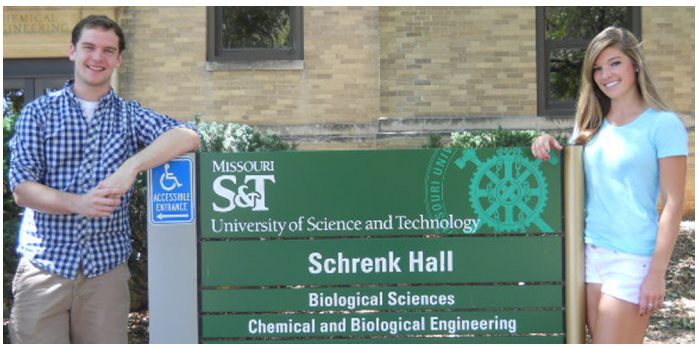
DR. ROBERT L PHILLIPS, JR. was awarded a Professional Degree at the May 2013 graduation ceremony. Dr. Phillips, vice president for research and policy with the American Board of Family Medicine, earned a bachelor of science from Missouri S&T in 1990. DR. PHILLIPS was appointed by the U.S. Secretary of Health and Human Services to serve on a federal committee to redesignate medically underserved areas, and served as vice chair of the U.S. Council on Graduate Medical Education. DR. PHILLPS completed his family medicine residency at the University of Missouri-Columbia, and is a member of the Institute of Medicine and the National Academies of Science.



Dr. Phillips was awarded the Professional degree at the graduation ceremony in May

Two Bio Sci Students Selected as Bryant Scholars

The Bryant Scholar Pre-admission program is open to high achieving students from rural areas of Missouri. Qualified students apply after their sophomore year of college, and if selected, are pre-admitted to the University of Missouri School of Medicine. To qualify, students must have a minimum 3.3 GPA, exhibit leadership skills, and participate in a variety of extracurricular activities. The program is designed to increase the number of physicians in rural areas of the state. The Biological Science department is proud to announce that two Bryant Scholars were selected from our department this year. Congratulations to JAMIE PHELPS and KATLYN MEIER on their accomplishments!



Field Courses in the Biological Sciences

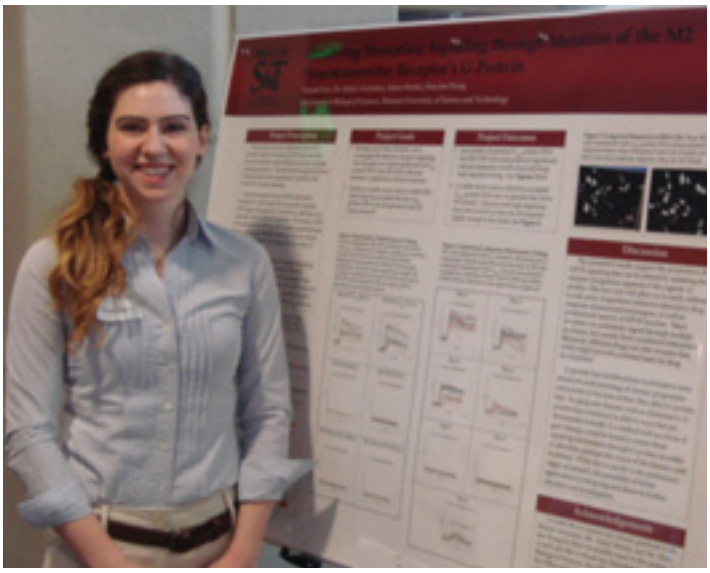
Students examine biodiversity on San Salvador Island

Cave salamander found during the cave biology field course

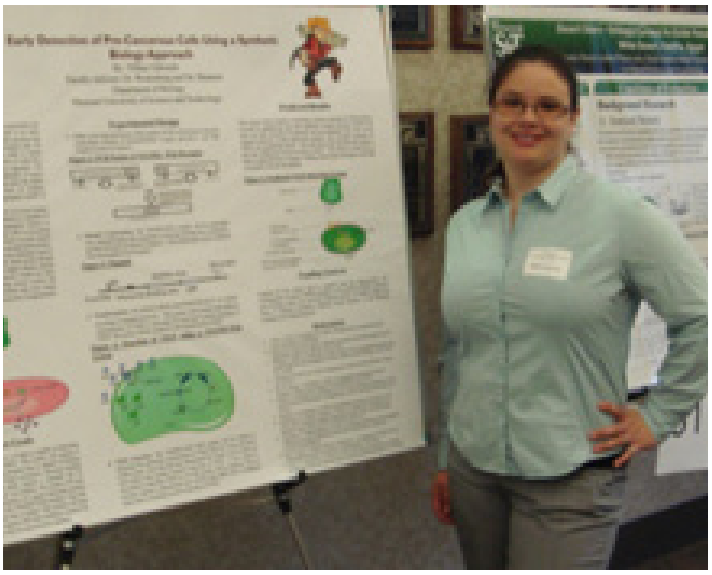
Several courses were offered this year that allowed students to participate in field work as part of the course. In the spring, Advanced Biodiversity was offered. This course focused on the impacts, both positive and negative, to biodiversity, as well as the techniques required to measuring biodiversity. Topics include biogeography, community structure, competition, predation, food webs, geology-biology relationships, environmental change, and human impact. At the end of the course, DR. MELANIE MORMILE and Dr. Dave Wronkiewicz, Associate Professor of Geochemsity, led students on a week-long field trip to explore bidiversity on San Salvador Island in the Bahamas. Students visited the Gerace Research Center and studied the many varied habitats on the island, including hypersaline lakes, shrub-covered terrestrial settings, rocky keys, sea grass beds, mangroves, and coral reefs.

Two summer courses also gave students an opportunity to get outside and explore biology. DR. DEV NIYOGI offered his popular Field Ecology course again this past summer. There was also a new Cave Biology field course offered by MS. MARIA POTTER, director of Onondaga Cave State Park and a 2010 M.S. graduate of the BioSci department. Over twenty students were introduced to the study of cave organisms and cave ecosystems. Students learned about growth of speleothems, caves as natural laboratories, behavior of cave animals, and regressive characteristics of cave species.

Biological Sciences Students Win Awards at Annual Undergraduate Research Symposium



Hannah Frye with her poster



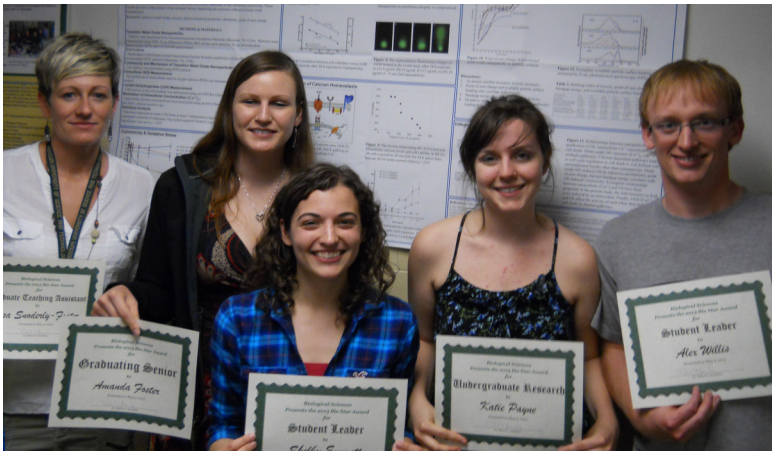
Tiffany Edwards presents her research proposal.

Biological Sciences students won several awards at the Annual Undergraduate Research Conference in April 2013. KATIE PAYNE won second place in the Sciences Oral Presentation with her talk titled "Insulin Neck": Is this the Earliest Sign of Insulin Resistance?" Her advisor is Dr. William Van Stoecker in Computer Science. Third Place in the sciences poster session went to HANNAH FRYE for "Modifying Muscarinic Signaling through Mutation of the Neurotransmitter Receptor M2's G Protein ". Her research advisor was DR. ARONSTAM. In the Research Proposal Poster Session, TIFFANY EDWARDS won third place for "Early Detection of Cancer Cells Using an Angiogenic Receptor in *E. Coli*", and DANI GAITAN won first place for "*E.coli* Administration of GLP1 in the Presence of Glucose." Advisors for the proposal winners were DRS. WESTENBERG and SHANNON. Congratulations to our winners and all students who presented their research.

Biological Sciences Announces 2013 Bio Star Award Winners

The winners of the fifth annual Bio Star awards were announced at the end of semester party in April. The awards recognize outstanding achievements by Biological Sciences undergraduates and Masters students. Winners received a certificate, flash drive, and candy bar in recognition of their achievement. Nominations were submitted by students and faculty, and the winners were chosen by a faculty committee. Congratulations to all the winners!

The 2013 Bio Star Winners are:
Graduating senior - AMANDA FOSTER
Graduate TA - LISA SNODERLY-FOSTER
Graduate research - DANIEL ROUSH
Undergraduate research - KATIE PAYNE
Student leader - SHELBY EMMETT and ALEX WILLIS



From left to right, Bio Star award winners Lisa Snoderly-Foster, Amanda Foster, Shelby Emmett, Katie Payne, and Alex Willis. Not pictured: Daniel Roush.

Seventy-eight BioSci Students Named Academic Scholars

Fatima Alqarous	Matt Coats	Shelby Emmett	Jeremiah Herbert	Desirae Lavatai	Katie Nelson	Lisa Simone
Kaleb Bassett	Justin Cole	Ethan Engel	Ava Hughes	Kent Lln	Hailee Parks	Amity Sparkman
Adrian Black	Sierra Comer	Elena Fisher	Kelsey Hunt	Michael Lockett	Karin Patel	Laura Stephens
Brittany Brand	Rachel Connell	Dani Gaitan	Sahitya Injamuri	Andrew Lott	Sarah Paunicka	Elizabeth Thoenen
Melissa Cambre	Kylie Cooper	Rachel Glenn	Michael Jennings	Erica McFarland	Katie Payne	Charles Threadgill
Aaron Carson	Kevin Creighton	Victoria Grill	Lawrence Jerichow	Crystal Meeks	Jamie Phelps	Chance Walker
Alyssa Castro	Kelsey Crossen	Carolyn Harper	Mikkah Kennedy	Katlyn Meier	April Pummell	Thomas Warner
Chantal Chambers	Brandon Drennen	Erin Harvey	Timothy Kenny	Kate Menke	Michelle Rojo	Lydia Wilcox
Craig Clark	Tiffany Edwards	Raheel Hassan	Toni Knar	Daniel Meyer	Sarah Rommelfanger	Caitlyn Wilkes
Rachel Clark	Chelsea Ehret	Peter Haw	Brieanna Kroeger	Samuel Meyers	Kayli Sharpell	Alex Willis
Samantha Clemens	Misha Emanoil	Matthew Hayes	Paige Kruse	Candace Miller	Zachary Siegal	Amanda Wilson
						Christine Wood

Biological Sciences Graduate Student News

Five new graduate thesis students joined the department: CARLOS RIVERA is working in the Sleep Biology lab, BRIAN HASLAG joined the lab of Rhizosphere Microbiology, LARRY TOLLIVER is in the Environmental Toxicology Laboratory, AMUNUGAMA PALIHAWADANA is conducting research in the Lab of Animal Physiology, and TIFFANY EDWARDS is in the lab of Environmental Microbiology.

One Graduate Student defended her thesis:

MEGAN OTTOMEYER "*Broad Spectrum Antibacterial Properties of Metal Ion Doped Borate Bioactive Glasses for Clinical Applications*"

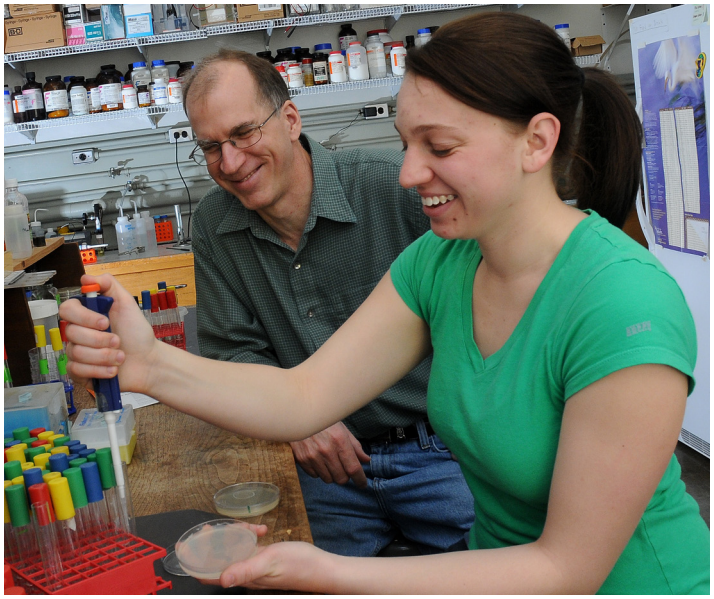


Photo shows Masters student Megan Ottomeyer with her thesis advisor Dr. Westenberg

2013 BioSci Graduates

Twenty nine Missouri S&T students received a B.A. or B.S. in Biological Sciences during the spring of 2013.

BioSci graduates at the May 2013 commencement ceremony.

MISSOURI S&T
University of Science & Technology

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Constitutive Receptor Activity Studied

Most communication between cells in the human body involves secretion of a chemical (such as a hormone or neurotransmitter) that binds to a specific site (a "receptor") on the receptive cell. Receptors are the single most important site of action of drugs; almost 60% of the drugs prescribed in the United States act on some kind of cellular receptors.

Accordingly, a great deal of research is being performed on the pharmacology (drug interactions) of cellular receptors. One of the most unexpected recent findings in this field is that a substantial number of receptors signal in the absence of an activating chemical and are turned off when they bind their native signaling molecule. These receptors have been termed "Constitutively Active (or CA) receptors.

It can be difficult to identify the chemical signals that activate CA receptors since they are turned off rather than turned on by the chemical. Recently scientists in the S&T Laboratory of Neurobiology have devised a scheme to identify constitutive activity in a group of "orphan" receptors. Orphan receptors are receptors for which the native activating signaling chemical has not been identified.

A research team led by ADAM MARTIN and ROBERT ARONSTAM surveyed 40 orphan receptors for constitutive activity in pathways involving the transducer proteins, Gα-s and Gα-i, using a cAMP sensitive luciferase-coupled reporter assay. Signaling through the Gα-s pathway increased luciferase expression under control of the cAMP response element (CRE), while Gα-i pathway activity inhibited expression induced by 3 μM forskolin. Remarkably, 85% (34 of 40) of the orphan receptors exhibited some form of constitutive activity. Different patterns of activity revealed receptor that were constitutively active in one, both or neither pathway. These findings suggest that constitutive activity by Gα-i mediated pathways, and to a lesser extent Gα-s mediated pathways, plays a prominent role in most orphan receptors. Moreover, this approach could help identify the native activating chemical signals.

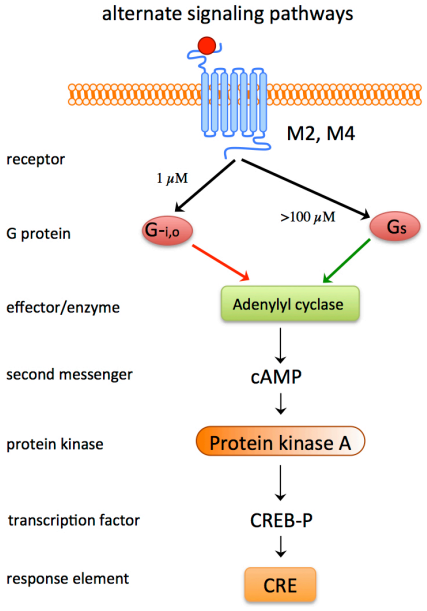

Figure Legend: Signaling pathway used to detect constitutive activity in orphan receptors. Receptors (blue) can signal through Gα-i or Gα-s proteins (red) to stimulate adenylyl cyclase, thereby initiated a series of events that affect protein expression under control of the CRE promoter (orange). By artificially associating a CRE promoter with a light-emitting enzyme from fireflies, an assay was developed that allowed us to determine signaling by orphan receptors in the absence of activating ligand. Unexpectedly, most orphan receptors demonstrated constitutive activity.